

REMARKS

Claims 1-23 remain in the application. By this amendment, independent claims 1 and 12 have been amended to more clearly define the invention, dependent claim 8 has been amended to correct a clerical error, and dependent claims 2, 3, 13, and 14 have been canceled. The present application as originally filed supports these amendments. No new matter has been added.

I. Claims 1, 3, 4, 12, 14, 15, 16, and 18

Claims 1, 3, 4, 12, 14, 15, 16, and 18 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,833,846 to Tanabe et al.. Issue is taken with that position. In these claims, claims 1 and 12 are independent claims, and other claims depend directly or indirectly from claims 1 and 12. Claims 2 and 14 have been canceled by this amendment.

The Office Action rejects both independent claims 1 and 12 under 35 U.S.C. 103(a) based solely on the Tanabe et al. patent. Tanabe et al. discloses a system for treating water, which includes a primary deionizing system and a secondary deionizing system (column 3, lines 7 to 31, and column 7, lines 20 to 60). The primary deionizing system produces deionized water, which is forwarded to the secondary water deionizing system, which includes a water tank 107, an ultraviolet (UV) oxidizer 108, a cartridge polisher 109, and a membrane separation unit 110.

The present invention is directed to methods and devices for treatment of water to produce ultrapure water. In water purification, ultraviolet light is typically used to break down organic materials and convert non-ionized or non-ionizable materials to ionized or ionizable materials so that they are removable in a following ED/EDI device. One problem with UV treatment that has not been addressed by the cited prior art reference is that the UV treatment can also change certain already removable components such that they become no longer removable by the following ED/EDI device. The present invention addresses this problem by providing a treatment method/system, which includes first processing the water with a deionization apparatus to remove from the water ionized organic carbon compounds and certain organic compounds that are ionizable in the deionization apparatus, and immediately after that, contacting the water with an agent for converting non-ionized and/or non-ionizable organic carbon compounds into ionized and/or ionizable organic carbon compounds, and then processing the water with a second

deionization apparatus to remove the ionized and/or ionizable organic carbon compounds. The method in the present invention pre-removes the ionized or ionizable materials so that the UV oxidizer could not convert them to non-removable materials.

In view of Tanabe et al., one skilled in the art should understand that the relevant processing units (the UV oxidizer 108, the cartridge polisher 109, and the membrane separation unit 110) are all in the secondary treatment system that processes the water from the primary treated water tank 107. The water tank 107 and the static storage conditions of that portion of the system are the source of total organic carbon (TOC). The water tank 107 should be viewed as the source that is to be treated by the following secondary system. In the secondary treatment system, which is located after the water tank 107, there is only a cartridge polisher 109 following a UV oxidizer 108, and there is no deionization device placed after the water tank 107 and before the UV oxidizer 108 to remove the ionized or ionizable materials before they are converted to non-removable materials by the UV process. The ion exchanger 106 in Tanabe et al. is placed before the water tank 107, and could not treat the source water stored in the water tank 107. Tanabe et al. actually discloses conventional methods and devices for treating a source water (stored in the water tank 107), which include UV treatment 108 followed by a cartridge polisher 109. In contrast, the present invention includes a series of two deionization steps/devices and a UV treatment step/device positioned therebetween, and the whole series of treating processes/devices are placed after the source water (which is the water tank 107 in Tanabe et al.). The Office Action points to a collection of various units located before and after the source (the water tank 107), and thereby concludes that the present invention is obvious. That conclusion is not appropriate and is respectfully traversed.

Moreover, if we view the primary deionizing system and the secondary deionizing system in Tanabe et al. as a whole, Tanabe et al. still could not render the present invention obvious. Tanabe et al. (FIG. 1) shows a first TOC source 1, followed by an ion exchanger 106, then followed by a deionized water tank 107 (which can be viewed as a second TOC source), followed by the UV oxidizer 108, cartridge polisher 109, and the membrane separation unit 110. The arrangement in Tanabe et al., which includes two TOC sources, at least one of which immediately precedes the UV treatment, is clearly different from the present invention. The present invention has a deionization process/device that immediately precedes the UV treatment.

The water tank 107 in Tanabe et al., which is conventionally the source of TOC generation, and which is positioned before the UV oxidizer, brings in more organic compounds, and certain of these compounds could be converted to non-removable materials by the following UV treatment. There is no suggestion of arranging a first and a second deionization devices before and after the UV treatment, as claimed by claims 1 and 12, so as to reduce the concentration of certain organic materials that would convert to non-ionized or non-ionizable materials by the UV treatment.

Furthermore, Tanabe et al. is directed to a boron removal device, and because all the other units leak boron into the otherwise highly purified water, the boron removal bed is placed near the downstream end of the primary deionizing system. However, the boron removing unit 1 itself is a source of TOC. As shown in FIG. 2 and described in Example 2, Tanabe et al. suggests to place the boron removing unit 1 between the water tank 107 and the UV oxidizer 108. Both the water tank 107 and the boron removing unit 1 are TOC sources, which generate materials that could be converted to non-removable materials by the following UV treatment. There is no awareness or discussion that the UV treatment would convert certain ionized or ionizable materials brought by the TOC sources (the boron removing unit 1 and the water tank 107) to non-removable materials by the following purification process, and so there is no suggestion of placing a deionization device directly before the UV oxidizer for removing the ionized or ionizable materials before the UV treatment, as claimed in the present application.

In view of Tanabe et al., one skilled in the art should appreciate that Tanabe et al. discloses a device having at least one TOC source (the water tank 107) placed directly before the UV oxidizer 108. Tanabe et al. neither recognizes the problem faced in the art, nor suggests any method or device to solve this problem. Tanabe et al. neither teaches nor suggests the present invention. Applicant respectfully submit that independent claims 1 and 12 are not obvious over Tanabe et al. under 35 U.S.C. 103(a).

Claim 4 depends from independent claim 1, and claims 15, 16, and 18 depend from independent claim 12. Since claims 1 and 12 should be patentable over Tanabe et al., the dependent claims 4, 15, 16, and 18, which include all the limitations of the base claims, also should be patentable over Tanabe et al..

II. Claims 2, 5, 8, 13, and 17

Claims 2, 5, 8, 13, and 17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tanabe et al. as applied to claims 1, 3, 4, 12, 14, 15, 16, and 18 above, and further in view of U.S. Patent No. 5,116,509 to White.

Claims 2 and 13 have been canceled by this amendment. Claims 5, and 8 depend from independent claim 1, and claim 17 depends from independent claim 12. As discussed above, independent claims 1 and 12 should be patentable over Tanabe et al. White discloses a water treatment process, in which water is first exposed to UV radiation, and then the UV-treated water is passed through an electrodeionization apparatus. White also fails to teach or suggest a process/device for purifying water including a series of treatment which includes first and second deionization processes/devices before and after the UV treatment/device, as claimed in independent claims 1 and 12.

The Examiner further states that, White, in column 1, lines 28-47, "teaches removing TOC from water by treating the water with deionization, ultraviolet light exposure, and recirculating the water between this treatment, which substantially cover the limitations of oxidation between deionization, and the limitations of claim 2 of using the same treatment unit in both deionization treatment". Claims 2 and 13 have been canceled by this amendment. Claims 1 and 12 have been amended. The present invention now recites a first deionization means placed before a conversion means, and a second deionization means, which differs from the first deionization means, placed after the conversion means, and a recovering means placed after the second deionization means. White fails to teach a series of devices includes a first deionization means, a conversion means, a second deionization means, and a recovering means. Independent claims 1 and 12 should be patentable over White. Therefore, the present invention as claimed in claims 1 and 12 are patentable over Tanabe et al. and White, and dependent claims 5, 8, and 17, which include all the limitations of the base claims should also be patentable over Tanabe et al. in view of White.

II. Claims 1-4, 6, 7, 12-16, and 18

In paragraph 4, the Office Action further states that the rejection of claims as discussed in paper No. 14 paragraphs 6 and 7 are maintained. Paper No. 14, apparently the Office Action of May 21, 2002, paragraph 6 has rejected claims 1-4, 6, 7, 12-16, and 18 under 35 U.S.C. 103(a) as

being unpatentable over U.S. Patent No. 4,863,608 to Kawai et al. in view of U.S. Patent No. 4,676,908 to Ciepiela et al. Applicant respectfully traverses these rejections.

More particularly, the Examiner takes the position that Kawai et al. discloses the process of treating and purifying water including reverse osmosis, ultraviolet light radiation, and ion exchange, and Ciepiela et al. discloses reverse osmosis as equivalent to ion exchange for purpose of removing carbonate or ionic species in water. The asserted rejections appeared to assert equivalence of reverse osmosis, ion exchange, and various forms of electrodialysis. Applicant respectfully disagrees with the Examiner's assertion.

As should be understood by person skilled in the art, reverse osmosis is different from deionization. Reverse osmosis uses a membrane that is semi-permeable, allowing the fluid that is being purified to pass through it, while rejecting the contaminants that remain. The process of reverse osmosis requires a driving force to push the fluid through the membrane, and the most common force is pressure from a pump. Reverse osmosis is used for removing contaminants in water purification, but for the purpose of deionization, reverse osmosis is not as effective as methods or devices particularly designed for deionization (e.g. electrodeionization). The deionization process in the present invention, which is directed to produce ultrapure water, is designed to remove ionized or ionizable materials, which would be converted to non-ionized or non-ionizable materials by the following UV treatment and become non-removable by the following deionization process. Reverse osmosis cannot ionize materials, and cannot remove certain materials, which are removable in deionization process. Although Ciepiela et al. states that "the electrodialysis unit 46 and/or the ion-exchange unit 64 may be replaced by a reverse osmosis (RO) unit...", Ciepiela et al. neither indicates that reverse osmosis and ion-exchange have the same function and produce the same result, nor states that they are interchangeable. As discussed above, the mechanism and the function of reverse osmosis, and the devices used in reverse osmosis are different from deionization process, and one skilled in the art should understand that reverse osmosis and deionization are not equivalent or interchangeable. Kawai et al. and Ciepiela et al., either considered along or in combination, do not teach or suggest the present invention as claimed in claim 1 and claim 12.

Moreover, in the new amended claims 1 and 12, the first and second deionization devices

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have been amended to select from the group consisting of electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiuresis apparatus. Reverse osmosis is neither a member of this group, nor equivalent to any member of the group. Therefore, Applicant respectfully submits that independent claims 1 and 12 are patentable over Kawai et al. in view of Ciepiela et al.

Claims 2, 3, 13, and 14 have been canceled by this amendment. Since claims 4, 6, and 7 depend on independent claim 1, and claims 15, 16, and 18 depend on independent claim 12, claims 4, 6, 7, 15, 16, and 18 all should be patentable over Kawai et al. in view Ciepiela et al. Applicant respectfully requests the Examiner to reconsider and withdraw the rejections to claims 1, 4, 6, 7, 12, 15, 16, and 18.

IV. Claims 1-6, 10, 12-19, and 21-22

In paragraph 7 of the Office Action of May 21, 2003, and as restated in paragraph 4 of the Office Action of June 17, 2003, claims 1-6, 10, 12-19, 21-22 were rejected under 35 U.S.C. 103(a) as being unpatentable over JP 61101292 to Tsutomu and JP 53149873 to Masabumi or U.S. Patent No. 5,118,422 to Cooper et al.

A. Tsutomu (292')

The Examiner alleges that Tsutomu (292') discloses an apparatus and a process of removing organic substances from water, and the process includes radiation, ion exchange, second radiation, and second ion exchange, and therefore, the combination of claim 2 (in the present application) is disclosed. Applicant respectfully disagrees.

In the present application, the first and second deionization apparatus are selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiuresis apparatus. All of the above mentioned devices are electrical devices, and the ion exchange device (process) disclosed in Tsutomu (292') does not belong to the claimed group. Furthermore, Applicant has amended claims 1 and 12 to more clearly define the invention. The first and second deionization apparatus in claims 1 and 12 as amended are selected from the group consisting of electrodeionization apparatus, electrodialysis apparatus, filled cell

electrodialysis apparatus and electrodiagnosis apparatus. Applicant believes that the amended claims further distinguish the first and second deionization devices from the ion exchange device in Tsutomu (292'). Therefore, Tsutomu (292') fails to teach or suggest a series of treatment/device, which includes a first deionization device (e.g. electrodeionization device), a conversion means (e.g. UV), and a second deionization device (e.g. electrodeionization device), as claimed in claims 1 and 12. Therefore, the present invention as claimed should be patentable over Tsutomu (292').

B. The combination of Tsutomu (292') and Masabumi (873')

The Examiner further states that Masabumi (873') discloses UV treatment in combination with reverse osmosis, and since reverse osmosis and electrodialysis are considered equivalent, it would be obvious to one skilled in the art to substitute reverse osmosis by electrodialysis. Applicant respectfully disagrees.

Masabumi (873') discloses a process of treating water with reverse osmosis followed by a UV treatment. The process in Masabumi (873') does not include a second deionization process to remove the resulting ionized/ionizable materials of the UV treatment. Therefore, Masabumi (873') also fails to teach the treatment series of the present application.

The combination of Tsutomu (292') and Masabumi (873') also does not render the present invention obvious.

Firstly, there is no motivation or suggestion to combine Tsutomu (292') and Masabumi (873'). Masabumi (873') discloses a process of treating water with reverse osmosis followed by a UV treatment (abstract). Tsutomu (292') discloses a process including radiation, ion exchange, second radiation, and second ion exchange (abstract). There is no suggestion or motivation to replace the reverse osmosis in Masabumi (873') with a deionization device, and then combine these two prior art patents together.

Secondly, as stated in subsection III, the deionization process in the present invention, which is directed to produce ultrapure water, is designed to remove ionized or ionizable materials, which would be converted to non-ionized or non-ionizable materials by the following UV treatment and become non-removable by the following deionization process, and reverse

osmosis cannot ionize materials, and cannot remove certain materials, which are removable in deionization process. Furthermore, the deionization devices in the present application have been limited to select from electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiagnosis apparatus, which are all different from reverse osmosis, and Applicant choose not to claim reverse osmosis. Person skilled in the art should understand that reverse osmosis and the claimed deionization device/process are not equivalent or interchangeable, and the present invention should be patentable over Tsutomu (292') in view of Masabumi (873').

C. The combination of Tsutomu (292') and Cooper et al. (422')

The Examiner also asserts that Cooper et al. (422') discloses the treatment of permeate form reverse osmosis membrane and ultraviolet radiation driven by photocatalytic post-treatment, and based on the argument that reverse osmosis is equivalent to the deionization process as claimed in the present application, the Examiner concludes that the present invention as claimed would be obvious over Tsutomu (292') in view of Cooper et al. (422').

The process disclosed in Cooper et al. (422') does not use a second deionization device to remove ionized and ionizable materials from the product stream of UV oxidation. Therefore, Cooper et al. (422') also fails to teach or suggest the treatment series as claimed in the present application.

There is no motivation or suggestion to combine Tsutomu (292') and Cooper et al. (422'). Cooper et al. (422') discloses a process of photocatalytic treatment of water. Tsutomu (292') discloses a process including radiation, ion exchange, second radiation, and second ion exchange (abstract). There is no suggestion or motivation in these two prior art patents to combine these two prior art patents together.

Also, as stated above, reverse osmosis is not equivalent to the deionization devices in the present application, which are selected from electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiagnosis apparatus. For the purpose of removing ionized or ionizable materials, reverse osmosis is not as effective as the claimed deionization devices. Therefore, the combination of Cooper et al. (422') and Tsutomu (292')

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also fails to disclose the claimed invention. The present invention as claimed should be patentable over Tsutomu (292') in view of Cooper et al. (422').

Furthermore, the combination Tsutomu (292') and Cooper et al. (422') does not suggest removing certain ionizable material in the first deionization device that would convert to non-ionizable material in the UV treatment. Indeed, Cooper et al. (422') appears to address the inadequacy of UV treatment by instead making the UV treatment harsher, photocatalytic or otherwise more effective to assure effective breakdown. This does not teach or suggest the two-step deionization process with UV in between to affect the types and susceptibilities of the organic contaminants present in the stream as claimed in the present application.

In summary, none of the Tsutomu (292'), Masabumi (873') and Cooper et al. (422') recognizes the problem of the UV treatment in the art, and none of them provides a solution for this problem. The combination of Tsutomu (292') and Masabumi (873') or Cooper et al. (422') does not render the claimed invention obvious. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Conclusion

Applicants, accordingly, respectfully submit that in view of the preceding amendments and arguments, claims 1, 4-12, 15-23 are patentable over the cited references, whether considered alone or in combination, and respectfully request reconsideration and withdrawal of the rejections of these claims under 35 U.S.C. 103(a). If a telephone conference will expedite prosecution of the application the Examiner is invited to telephone the undersigned.

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No additional costs are believed to be due in connection with the filing of this paper. However, the Commissioner is hereby authorized to charge any additional fees, or credit any overpayment, to our Deposit Account No. 50-1133.

Respectfully submitted,
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